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III. *Extraëts from Mr. Gascoigne's and Mr. Crabtree's Letters, proving Mr. Gascoigne to have been the Inventor of the Telescopic Sights of Mathematical Instruments, and not the French. By W. Derham, Prebend of Windsor, and R. Soc. Soc.*

**I**N *Monsieur de la Hire's* first Part of his *Tabula Astron.* published in 1687. I find an Invention, which was undoubtedly our Countryman Mr. Gascoigne's, ascribed to *Monsieur Picard*, and that is, the Application of Telescopic Sights to Astronomical Instruments. Mr. de la Hire's Words are, *Paucis abhinc annis D. Picard insignis Astronomus, atque in eadem Academia [Regiâ. Scientiarum] Socius, Dioptrarum crenas ab instrumentis sustulit, eorumque loco substituit Telescopia; quæ res Presbytis & Myopibus, &c.* In which Words it is not indeed expressly said that Mr. Picard was the Inventor of this way, but only that he applied Telescopes. But by reason it implies that it was that curious and ingenious Gentleman Mr. Picard's Invention, and it is in effect claimed as such, in *Monsieur Luzzout's* Account of the Telescopic Micrometer, in the *Philos. Transf* No. 21. therefore I think my self in Duty bound, to do that young but ingenious Gentleman, Mr. Gascoigne, the Justice, to assert his Invention to him; by reason all his Papers, that by the late ingenious Mr. Torneley's Diligence could be picked up, are now (together with Mr. Torneley's own Papers) in my Hands.

As for the Invention of the Micrometer, which Mr. *Auzout* claims as his and *Monfieur Picard's*, I shall say little to it, Mr. *Towneley* having sufficiently prov'd it to be Mr. *Gascoigne's*, in the *Philos. Transact'* No. 25. And the Descriptions and Draughts of that, and some other Instruments of that kind, are now by me, in Mr. *Gascoigne's* own Hand, to confirm Mr. *Towneley's* Account, if occasion were.

And as Mr. *Gascoigne* was the first that measured the Diameters of the Planets, &c. by a Micrometer; so I shall prove that he was the first that applied *Telescopick Sights* to Astronomical Instruments. In a long Letter to his sagacious Friend Mr. *Crabtree*, of Jan. 25. 1642. (wherein he describes his Micrometer, and shews his way of finding the Refractions, the Moon's Parallax, and how he measured the Diameters of the Planets) Mr. *Gascoigne* tells him how the measuring Glasses, which he had been speaking of, might be applied to a Quadrant. If, saith he, here (that is in the Distinct-Base) you place the Scale that measures —, or, if here an Hair be set, that it appear perfectly through the Glass —, you may use it in a Quadrant, for the finding of the Altitude of the least Star visible by the Perspective wherein it is. If the Night be so dark, that the Hair or the Pointers of the Scale be not to be seen, I place a Candle in a Lanthorn, so as it cast Light sufficient into the Glass; which I find very helpful when the Moon appeareth not, or it is not otherwise light enough.

In another Letter, dated on Christmas Eve 1641. (wherein he describes the Wheel Work of his Micrometer, and shews how he could apply it to the taking of three Points; and specifies his Observations of the Diameters of the Sun and Moon; and mentions a Theory he had contriv'd of the Sun; &c. and saith what pains he had taken in the Anatomy of the Eye) he tells Mr.

*Crab-*

*Crabtree* how he had applied his Telescopic Sights to a Sextant. Saith he, *Mr. Horrox his Theory of the Moon I shall be shortly furnished to try. For I am fitting my Sextant for all manner of Observations, by two Perspicills with Threads. And also I am consulting my Workman about the making of Wheels like  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ , of † Diagr. 3, to use two Glasses like a Sector. If I once have my Tools in readiness to my Desire, I shall use them every Night. I have fitted my Sextant by the Help of the Cane, two Glasses in it, and a Thread, so as to be a pleasant Instrument, could Wood and a Country-Joiner or Workman please me.*

In another Letter (the Date of which is worn out, but is, in *Mr. Crabtree's* Hand, called his 10th Letter to him) he saith, *I have given order for an Iron Quadrant of Five Foot, which will give me the 1000th Part of One Degree, which shall be furnished like my first Scale; only my Workman is so \* throng for my Father, that I fear it will not be finished before the Eclipse. I have caused a very strong Ruler to be exactly made, and intend to fit it with Cursors of Iron, with Glasses in them and a Thread, for my Sextant.*

To these I could have added many other Passages of the like Nature: but these may be sufficient, to shew that *Mr. Gascoigne*, as early as 1640, made use of Telescopes on Quadrants and Sextants, as well as in his Invention of the Micrometer.

What Commendations these Contrivances got him, and what Expectations they raised in some of the Astronomers of that Time, particularly in two of the most acute of that Age, *Mr. Horrox*, and *Mr. Crabtree*, may be seen in the same *Mr. Crabtree's* Letters to *Mr. Gascoigne*, which are also in my Hands. Some Passages of which I shall recite, and at the same time give the Society a Taste of what those curious Letters do contain.

† This Diagram is wanting in the Letter.  
for fully employed.

\* A Yorkshire Phrase

In Mr. *Crabtree's* second Letter, which is of *October 30. 1640*; after a very clear Demonstration that the Solar Spots are not Planets at a Distance from the Sun, but something adhering to, or very near the Sun's Body: and also after a no less clear Demonstration of the Errors of *Lansberges Hipparchian Diagram*, his *Lunar Parallax*, his Doctrine of *Eclipses*, and indeed his whole *Lunar Astronomy*, together with divers other curious Matters, too many to be specified: after this, I say, Mr. *Crabtree* saith thus, *Something I am sure you were telling me concerning a way of observing the Places of the Planets by your Glasses. But I have not a little lamented that my Time cut me so short, when I was with you, that I could not more fully ruminare and digest those strange Inventions which you shewed me, and told me of. My Lassitude after an unexpected and unacquainted Journey; my unpreparedness for those Cogitations (not intending that Journey the Day before) and the Multiplicity and Variety of the Novelities you shewed me, so wholly distracted my Thoughts into Admiration, that I cannot now give my Meditations any reasonable Account of what I saw: but must intreat you, in a few Lines, to rub up my Memory, and tell me again what you shewed me, and the Extent of those your Inventions. Which I desire, that I might consider, and rejoice to consider, how much and wherein Urania's Structure will grow to Perfection by your Assistance: and that (what in me lies) I may help you to remember when and wherein your Inventions and Observations will be of most use. I should also desire you to inform me what Bigness of a Quadrant you conceive to be large enough for Observation with your Devices. For I am ere long going to Wigan, 12 Miles from hence, where much Brass is cast; and then I could see whether I could procure such an one cast. You told me (as I remember) you doubted not in time to be able to make Observations to Seconds. I cannot but admire it and yet, by what I saw, believe it: but long*

to have some farther Hints of your Conceit for that Purpose. One Means, I think, you told me was, by a single Glass in a Cane, upon the Index of your Sextant, by which (as I remember) you find the exact Point of the Sun's Rays. But the way how, I have quite forgotten, and much desire: Your Device for the exact Division of a Quadrant, by dividing 11 Degrees into 10 Parts, I did then understand, but do not now fully remember. If it might not be too much Trouble to you, I should intreat you to give me such a Paper-Demonstration thereof as you shewed me, and two or three Lines plainly of the Use thereof, how to find those small Parts. I lost the little Paper, wherein I noted the Moon's Diameter, which we observed when I was with you: I pray you send it me, if, &c.

I cannot conceal how much I am transported beyond myself with the Remembrance (of that little I do remember) of those admirable Inventions which you shewed me when I was with you. I should not have believed the World could have afforded such exquisite Rarities, and I know not how to stint my longing Desires, without some further Taste of these selected Dainties. Happier had I been, had I never known there had been such Secrets, than to know no more, but only that there are such. Of all Desires the Desire of Knowledge is most vehement, most impatient: and of all kinds of Knowledge, this of the Mathematicks affects the Mind with most intense Agitations. I doubt not but you can experimentally witness the Truth hereof, and one time or other have been no Stranger to such Thoughts as mine. And therefore although Modesty would forbid me to request any thing (until you give me leave) but what you please voluntarily to impart, yet the Vehemence of my Desire forceth me to let you know how much I desire, and how highly I should prize any thing that you should be pleased to communicate to me in those Optick Practises. Could I purchase it with Travel, or procure it for Gold, I would not long be without a Telescope for ob-

*serv'ing small Angles in the Heavens ; nor want the Use of your other Device of a Glaſt in a Cane upon the moveable Ruler of your Sextant (as I remember) for helping to the exact Point of the Sun's Rays. But ſeeing Urania is, &c.*

Thus was the moſt ingenious Mr. Crabtree tranſported with Mr. Gaſcoigne's Devices, although at that time far leſs perfect than they were in a ſhort Time after. And no leſs affected was the incomparable Horrox, as Mr. Crabtree ſets forth, in his third long Letter of Dec. 28. 1640. which hath theſe Words, *My Friend Mr. Horrox profeſſeth, that little Touch which I gave him of your Inventions, hath raviſhed his Mind quite from it ſelf, and left him in an Extaſie between Admiration and Amazement. I beſeech you, Sir, ſlack not your Intentions for the perfecting of your begun Wonders. We travel with Deſire till we hear of your full Delivery. You have our Votes, our Hearts, and our Hands ſhould not be wanting, if we could further you. And then after many curious Matters (which would take up too much of the Societies time to relate) he thus proceeds, Your Diagrams for Perſpectives I have viewed again and again, and cannot ſufficiently admire your indefatigable Induſtry, and profound Ingenuity therein. I am much affected with the Symbolical Expreſſions of your Demonſtrations. I never uſed them before (but I will do) yet I underſtand them all at the firſt Sight, and ſee well the Truth of your Demonſtrations.*

To theſe I ſhall only add one Paſſage more, and this becauſe it ſhews ſome other of Mr. Gaſcoigne's exquisite Contrivances, or at leaſt the Accuracy of what are mentioned ; and that is in Mr. Crabtree's Letter of Dec. 6. 1641. at the Beginning of which he ſaith, *That which you give me a full Projection of was above my Hope : and if the Screws keep an exact Equality of Motion forward in each Revolve, it is a moſt admirable Invention ; and with the other Accommodations, I had almoſt ſaid without*  
Com-

*Compare. But that the Divisions of a Circle should be measured to Seconds, without the Limb of an Instrument, or that Distances, Altitudes, Inclinations, and Azimuths should be taken all at one Moment, without the Limb of an Instrument likewise, and each to any required Number of Parts; or that the Diameter of Jupiter should be projected in such prodigious Measures as you speak of, &c. were enough to amuse and amaze all the Mathematicians in Europe, and may indeed be rather a Subject of Admiration than Belief, to any that hath not known your former Inventions to exceed Vulgar (I had almost said Humane) Abilities. And for my Part, I must confess Modesty so checks my ambitious Desires, that I dare scarce hope such Miracles should ever be produced in real Practice to such Exactness. Then (to give the Society a further Taste of those Letters) follows an Account of the Agreement of Mr. Horrox's Theory of the Moon with Mr. Gascoigne's Observations; and also very curious Ratiocinations, and a Disquisition about finding the Parallax of the Sun and Moon, and their Distance from the Earth. In which he censures Morinus's Braggs, &c. and then saith, that no Man that hath written of the Diagram [of Hipparchus] understood it fully, or described it rightly, but only Kepler and our Horrox; for whose immature Death [which was suddenly, and about the Age of 25.] there is yet scarce a Day which I pass without some Pang of Sorrow.*

Thus, among many, I have related some of the Passages of Mr. Gascoigne's and Mr. Crabtree's Letters relating to *Telescopick Sights*. From whence it is very manifest, that long before the French Gentleman's Claims, our Countryman Mr. Gascoigne had made use of those Sights in his Astronomical Instruments; particularly in two or more Sorts of *Micrometers* (as I plainly find) and in his *Quadrant* and *Sextant*. And had it pleased God to have given him a longer Life, we might have expected



pected greater things from his pregnant and sagacious Wit. For he was scarce 20 Years of Age when he held these Correspondencies with Mr. Crabtree. And at the Age of 23. he was killed at *Marston-Moor-Battle*, on July 2. 1644. fighting for King Charles I. His Father was *Henry Gascoigne Esq;* of *Middleton*, between *Leeds* and *Wakefield*.

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IV. *An Attempt towards the Improvement of the Method of approximating, in the Extraction of the Roots of Equations in Numbers.* By Brook Taylor, Secretary to the Royal Society.

**I**N *Phil. Tran.* No. 210. Dr. Halley, now Secretary of the Royal Society. has publish'd a very compendious and useful Method of extracting the Roots of affected Equations of the common Form, in Numbers. This Method proceeds by assuming the Root desired nearly true to one or two Places in Decimals (which is done by a Geometrical Construction, or by some other convenient way) and correcting the Assumption by comparing the Difference between the true Root and the assumed, by means of a new Equation whose Root is that Difference, and which he shews how to form from the Equation proposed, by Substitution of the Value of the Root sought, partly in known and partly in unknown Terms.

In doing this he makes use of a Table of Products (which he calls *Speculum Analyticum*,) by which he computes the Coefficients in the new Equation for finding the Difference mentioned. This Table, I observed, was formed in the same Manner from the Equation  
pro-